

We should have thought that on this explanation the velocity of the electron, when sensibly outside the metal, would have been about zero instead of nearly that of light.

We regret the choice of electrostatic units, while thoroughly approving the adoption of a single kind instead of the mixed electrostatic and electromagnetic units which are so often met with.

Many data employed are those relating to an atom or an electron. There is doubtless gain as well as loss in making use of these instead of the corresponding data for (say) unit volume or unit mass. We think, however, that there is preponderating gain in writing all formulæ so as definitely to indicate to what extent the value accepted for the number of particles in a cubic centimetre influences the numerical result. Thus in the expression for electrical conductivity,

$$\sigma = \frac{1}{4\pi} e^2 h u N,$$

$\alpha$  is the gas-constant referred to an electron. Now  $\alpha/e$  is known with more certainty than either  $\alpha$  or  $e$ , and there is gain in writing  $eN$  as a product, so that the formula would be written—

$$\sigma = \frac{eN}{4\pi\alpha/e} \cdot lu.$$

Probably the most daring speculation in this book is in connection with the problem of aberration and æther drift. Our author desires to remove the difficulties in connection with this problem by denying the existence of the æther altogether. The scientific man, in accepting the æther, "has fallen into the most glaring errors of the crudest nominalism." Our author's explanation is based upon Faraday tubes. May we suggest that these Faraday tubes seem suspiciously like an æther, but with special properties attributed to it?

In many other respects we think that the author is too dogmatic in his assertions; his exposition would gain if the overbearing tone were modified. The reader also resents the too colloquial character of some sentences, such as, "My own vote is cast, for what it is worth, for the latter." Science does not advance by the mere casting of votes, whatever they may be worth.

Although we do not find ourselves in agreement with everything in this book, it is undeniably a very invigorating study of the subject. The publishers are to be congratulated on securing it, and also on the care taken in producing it. There are exceedingly few typographical errors; as proper names are important, we mention that Spender (p. 216) should be Spencer.

#### OCEANIC TIDES.

*Scientific Papers.* By Sir George Howard Darwin, K.C.B., F.R.S. Vol. i., *Oceanic Tides and Lunar Disturbance of Gravity*. Pp. xv+463. (Cambridge: University Press, 1907.) Price 15s. net.

THE syndics of the Cambridge University Press are bringing out in four volumes the collected papers of Sir George Darwin. The first volume is before us, and contains a list of about sixty papers

written between 1875 and 1906, that will be distributed over the four volumes.

Sir George Darwin's papers being easily separated into well-defined groups, the collected papers will not be in chronological order, but will be classified according to subject as follows:—Vol. i., *Oceanic Tides and Lunar Disturbance of Gravity*; vol. ii., *Tidal Friction with Astronomical Speculations*; vol. iii., *Figures of Equilibrium of Rotating Liquid*; vol. iv., *Periodic Orbits*.

The height of the tide at any point at a variable time  $t$  must be expressible as the sum of a number of periodic sine or cosine terms, the arguments moving uniformly with the time, and the coefficients being constant. The periods are mostly forced periods, and there is little difficulty in pointing out what they are. In addition there are the free periods. "A dynamical problem of this character," writes Sir George Darwin (p. 350), cannot be regarded as fully solved unless we are able not only to discuss the "forced" oscillations of the system, but also the "free." Hence we regard Mr. Hough's work as the most important contribution to the dynamical theory of the tides since the time of Laplace."

The coefficients of the forced oscillations are indicated by theory to some extent. We have first an equilibrium theory, and then a dynamical theory. ("The problem of the tidal oscillation of the sea is essentially dynamical," p. 349.) By laborious quadratures the effects of continents may be roughly taken into account. Finally we are driven back upon the empirical determination of coefficients from observation. This is dealt with in the sixth paper of the present volume. The work is theoretically easy, but most laborious in practice.

In the ninth paper the author concludes from tides of long period that the rigidity of the earth is about that of steel.

Tide prediction follows naturally, when the coefficients of the various superimposed tides have been obtained. An ingenious machine at the National Physical Laboratory, near Teddington, traces the combined effect of twenty-four different tides upon a chart. In two hours the curve that represents the tides of one year can be traced. It afterwards takes a computer a few days to measure the times of high and low water. The machine is used for forty different ports, and, it may be remarked, is therefore not overworked, as its services are required for eighty hours each year.

On p. 5 there is a schedule of notation of the principal tides, with the speed attached. The speeds are combinations of simple multiples, positive and negative, of the earth's rotation, and the mean motions of the sun, moon, and lunar perigee. The speeds are given numerically on pp. 20, 21, &c. On p. 139 we find tables of coefficients for Port Blair, which quickly and clearly indicate the relative importance of the various tides. On p. 116 we note that an attempt to detect the nineteen-yearly tide failed.

"The actual change of sea-level between 1870 and 1873 [at Karachi] was nearly 0.25 feet, and this is just about nine times the range of the nineteen-yearly

tide. It is thus obvious that this tide must be entirely masked by changes of sea-level arising from meteorological causes."

We cannot help thinking that the methods of harmonic analysis described on pp. 157-258 are a little unnecessarily cumbrous. One simplification we should like to suggest. Given the height of the tide at intervals of one solar hour, an approximate period exactly commensurable with a solar hour might always be taken for the tide under analysis. The difference between the true period and the assumed period will then appear as a progressive change of epoch in the successive periods of analysis; meanwhile the assumed period, involving exact repetition after an integral number of hours, immensely facilitates the harmonic analysis, as the present writer has found in an allied subject.

The second part of the volume deals with the lunar disturbance of gravity, and closes with a prediction:—

"I venture to predict that at some future time practical astronomers will no longer be content to eliminate variations of level merely by taking means of results, but will regard corrections derived from a special instrument as necessary to each astronomical observation."

#### GARDEN BOOKS.

(1) *Roses: Their History, Development and Cultivation.* By Rev. J. H. Pemberton. Pp. xxiv+336. (London: Longmans, Green and Co., 1908.) Price 10s. 6d. net.

(2) *Sir William Temple upon Gardens of Epicurus, with other Seventeenth-Century Garden Essays.* Pp. lxxii+272. (London: Chatto and Windus, 1908.) Price 1s. 6d. net.

(1) **T**HE English literature of the rose ranks higher, and is more abundant, than that of any other florist's flower. By general consent the most popular book on the subject was the late Dean Hole's work, entitled "A Book about Roses," which is read with interest even now for the personal reminiscences it contains. "The Rose Garden," by the late William Paul, is a standard work with invaluable illustrations, and "The Book of the Rose," by the Rev. Foster Melliar, of which a new edition was published shortly before the author's death, is an eloquent expression of the views and ideas of an enthusiast in respect to the qualities of the exhibition rose, and the methods of cultivation by which the plants may be induced to produce the most perfect flowers.

There are many other published works, some newer, others older, than those mentioned, yet such is the interest in the queen of flowers that rose cultivators will gladly welcome the latest contribution by the Rev. J. H. Pemberton.

Rose-growers visit the exhibitions of the National Rose and other societies, and they are induced to emulate the efforts of the best exhibitors. But if ordinary rose-culture is simple enough to those who are willing to give their time and care to the subject,

it is nevertheless true that the production of perfect blooms such as are capable of winning prizes at an important competitive exhibition is attended with all sorts of difficulties. The less experienced growers, therefore, are willing to learn from those who have already achieved success, and certainly no amateur has been more consistently successful over a long period of years than the author of the book under notice.

Mr. Pemberton tells us that his father was an ardent rose-grower, and Mr. Pemberton himself commenced to cultivate roses at the earliest opportunity, being tempted a short time afterwards to enter upon the more adventurous and exciting business of exhibiting his blooms at the competitive exhibitions.

The first portion of the book is devoted to explaining the botanical classification of roses, and to describing some of the more important of the wild species. Some of these are natives of Britain, but the larger number are exotic or foreign.

The author's request in the first chapter that readers will bear in mind that the rose is not an exotic loses much of its point when we remember that the Hybrid Perpetuals, Teas and Hybrid Teas have been obtained entirely from exotic species! These earlier chapters may be recommended to the study of hybridists, for they show clearly that very few species have yet been subjected to cross-breeding, and therefore there are good reasons for the belief that although the present variation in roses is very wide, even greater variation may be expected, and novelties that may establish types altogether distinct from those at present in cultivation.

The author has done well to exhort amateur cultivators to attempt the work of cross-breeding roses for themselves, and notwithstanding that the description given of the processes of fertilisation and fructification is not of scientific exactness, the chapter on raising seedlings will be likely to effect good.

In the second part of the volume Mr. Pemberton talks straight to the cultivator upon the details of cultivation, carefully and thoroughly explaining the systems of vegetative reproduction, such as budding, grafting, layering, and rooting of cuttings; the tilling and manuring of the soil, planting and pruning. In these pages the author's intimate and practical knowledge of his subject is plainly revealed, and the directions are given so lucidly and yet so tersely that to misunderstand them would appear impossible.

As the winner of hundreds of friendly battles Mr. Pemberton is able to afford most valuable hints and directions upon the subject of competitive exhibitions, and whilst his enthusiasm for these will be likely to beget also in his readers a desire to engage in the "Wars of the Roses," his helpful counsel will encourage them to do so with every prospect of obtaining some measure of success.

We are glad that in this book, written as it is by such an enthusiastic exhibitor, the case for the decorative value of roses in the garden is stated so fairly and sympathetically. Not all rose-growers wish to exhibit, but those who do not, equally with those who